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A Philoſophical Diſcourſe OF Earthquakes:

Occaſioned by the

Late Earthquake,

SEPTEMBER the 8th. 1692.

By *C. H.* Allywell.

Non tota ſolido Contextu Terra in unum uſq; funditur: ſed multis partibus Cava, & cæcis ſuſpenſa latebris, habet inania ſine humore. Sen. Lib. 5. Nat. Qu. C. 15.

LONDON,

Printed for *Walter Kettilby*, at the *Biſhop's Head* in St. *Paul's* Church-Yard, 1693.

A

Philosophical Discourse

OF

Earthquakes:

Occasioned by the

Late Earthquake,

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Nonnora foliis Centeria Terra in unum ufq; funda-
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A DISCOURSE OF Earthquakes.

AN Earthquake is the great inconvenience of Nature; and whereas all other evils admit of ſome remedy to alleviate them, nothing remains to this, but that it happens more ſeldome. Againſt Thunders, and when Nature ſeems to be in an angry fit among the Clouds, and throws down its deſtructive Fires, ſome deep ſubterraneous Caves may perhaps afford a refuge; ſuch as that reported to be made by *Auguſtus Cæſar* in the *Flaminian* way, where being affrighted with Lightning he uſed to retire. But againſt ſuch a voracious evil there is no ſecurity. The Sea

it ſelf affords no ſafety, when its Waters are ſwelled beyond their natural bounds, by the fury of ſubterraneous Exhalations.

The beſt uſe therefore we can make of theſe Prodigies and unuſal Accidents, is to contemplate the infinite Wiſdom and Power of God, in the contrivance of this Earth which we inhabit. The late Earthquake which hapned *Sept.* the 8*th.* was felt not only at *London*, but at the ſame time near fifty miles diſtant in *Suſſex*, where I then was; and which (as was obſerved by credible Perſons) ſenſibly ſhook one part of a Houſe, while the other was perfectly unmoved, and paſſed according to the bigneſs of the hollows and ramifications of vaſt ſubterraneous Cavern's, with a more or leſs ſenſible concuſſion. This unuſual Phænomenon with us, led me to the conſideration of the immediate Origine and Natural Cauſes of Earthquakes; not at all doubting, but that there is a higher Power which moderates and guides the blind impetus and force of ſuch raging and ferocient Motions. In order to which I ſhall conſider firſt the Frame and Structure of this preſent Earth, which I ſhall borrow from ſuch Authors as my preſent ſtation would allow me, and ſo far as my Judgment extends, reflect upon the Reaſons of their ſeveral Hypotheſes.

SECT.

SECT. I.

WE are to know therefore, That the Earth is no where one entire compacted Maſs, or ſolid Contexture, but bored through with infinite Burrows and Cavities, which paſs under the very bottom of the Sea, and diſpread themſelves into infinite Branches throughout the whole Terreſtrial Globe, like the Ramifications of Veins, and Nerves, and Arteries in the Humane Body. And as ſome of theſe are the Conduits to ſupply the Body with an aqueous Subſtance, ſo through others is derived a Subſtance more unctuous and balſamick: And laſtly, others convey up and down for the motion of the Corporeal Frame, a certain Igneous, Spirituous, and Celeſtial Matter. To which, by an eaſie Analogy, we may imagine, That ſome of theſe dark Receſſes, and deep Burrows, are no other than Aquæducts, and that by theſe this exteriour Sea may have a communication with that inmoſt or deepeſt Abyſs, and is carried to the roots of Mountains and Hills; where, as by certain Alembicks, it is diſtilled, and becomes in a great meaſure the Original of Fountains and Rivers, which by a conſtant current return back what they borrowed of the Sea. Others are like *Æolipyles*, wherein a conſtant Air or Wind is carried, which ſerves as well for the forcing the Waters into the dark Vaults, as for the exſuſcitation

tation and keeping alive that conſtant and perpetual Fire which Nature keeps under ground. And therefore as there is a conſtant paſſage through theſe ſubterraneous Burrows for Air and Water; ſo we cannot imagine but that ſuch an active Element as Fire ſhould every where pervade and paſs through them.

SECT. II.

NOW that the Earth is in all places full of theſe Cavities and hollow Paſſages, is evident,

1. From the communication that ſome Seas are ſaid to have one with another; as for inſtance, The *Caſpian* Sea amongſt others, receives into it that vaſt River *Volga* (of which *Varenius* in his Geography, *Lib.* 1. *C.* 16. *Propoſ.* 5. ſays, "That with-" in the compaſs of a Year it pours ſuch a quanti-" ty of Water into the *Caſpian* Sea, as would be " able to cover the whole Globe of the Earth,) without any viſible out-let. Therefore it being impoſſible that the redundancy of this Water ſhould be extracted by the Sun in vapours, this Sea muſt ſenſibly increaſe, and at laſt over-flow all its banks; which we find it does not, but continues with little or no variation in the ſame Altitude.

Hence

Hence it is very rationally ſuppoſed by modern Geographers, that it hath Communication with ſome other Seas by ſubterraneous Ducts and Chanels. Which *Athanaſius Kircher* in his *Mundus ſubterraneus*, *Tom.* 1. *c.* 13. *Sect.* 1. with great probability aſſerts to be theſe two chiefly: The firſt is a vaſt and infernal Cavern paſſing even under Mount *Caucaſus*, whereby the *Caſpian* diſburdeneth and diſchargeth it's Waters into the *Euxine* Sea, the whole Region of *Georgia* and *Megrelia* lying between, being as it were a Bridge over theſe Waters that paſs underneath; and this he proves firſt, from conſtant and daily obſervation, *viz.* That when the Eaſtern Winds do the moſt fiercely rage and exerciſe their force upon the *Caſpian* Sea, at the ſame time there are obſerved greater Ebullitions and Agitations in the *Euxine* Sea: And on the contrary, When the Weſtern Winds prevail, and violently agitate the *Euxine*, the *Caſpian* ſuffers unuſual perturbations: which is an evident ſign that theſe two Seas communicate one with another in reciprocal Motions through hidden and wide ſubterraneous Burrows. Secondly, he argues from ſome rejectaneous Offals found in the *Euxine*, which are proper only to the *Caſpian* Sea, ſuch as a certain kind of Alga or Seaweed, and Serpents, and the planks of ſhips made of ſuch timber as grows not about the *Euxine* but the *Caſpian* Sea. Whereby the Communication of theſe two Seas further appears.

The other Out-let or ſubterraneous Duct leads into the *Sinus Perſicus*, or Perſian Bay; in which there is a Vortex or Gulf, which at ſome times ſwallows up the Waters to a very ſenſible and remarkable decreaſe, and after a while the Chanel being full, no token or ſign of any Vortex appears. By which it is probably conjectured that when the *Caſpian* Sea agitated by violent Winds hath thrown much of it's Waters into the *Euxine* Sea, it is again repleniſhed from this *Perſian* Gulf. And the like Communication is found between the Red Sea and the Mediterranean by theſe hidden Burrows and Perforations under ground.

2. Another Argument of the hollowneſs of the Earth, is the paſſage of Rivers underground, which break forth again in diſtant places, and appear as new Rivers. The moſt famous of theſe is *Niger*, a River in *Africa*, which modern Geographers will have to be derived from *Nilus* by ſubterraneous Aqua-ducts: This great River having his Courſe obſtructed and ſhut up with a mighty chain of the Mountains of *Nubia*, hath either found or forced a paſſage under them, and meeting in thoſe ſubterraneous Vaults with a freſh ſupply, breaks out on the Weſtern ſide of thoſe Mountains and falls into the *Atlantick* Ocean.

Thus *Tygris* in *Meſopotamia* croſſing the Lake *Arethuſa*, and meeting with the Mountain *Taurus*, loſeth himſelf there in a vaſt and deep Den or Cave, and ariſeth again on the other ſide; afterwards

wards passing through the Lake of *Thospites*, he again hides himself under ground, where traveling about six *German* Miles, he breaks forth anew, and continues his course till not far from *Babylon*, he falls into *Euphrates*.

Aristotle, in his Meteors, takes notice of many such Rivers about *Arcadia*, in *Peloponnesus*, absorped in gaping Hollows of the ground, and at some distance emerging again. *Lycus* and *Erasinus* are mentioned by *Ovid*, *Met.* 15.

Sicubi terreno Lycus est epotus hiatu,
Exsistit procul hinc, alioque renascitur orbe.
Sic modo combibitur, tecto modo gurgite lapsus
Redditur Argolicis ingens Erasinus in agris.

Some of the *Greek* Writers affirm, that *Alpheus*, a River of *Achaia*, is drunk up by a wide *Hiatus*, or opening of the ground, and passes in its hidden Burrows, even into *Sicily*, and ariseth in the shoar of *Syracuse*, where it is known by the name of *Arethusa*: and to confirm their conjecture, they say that every fifth year *Arethusa* in *Sicily* casts up dung of beasts at the same time when the Olympick Games were celebrated in *Achaia*, and the dung and offal of the Sacrifices thrown into *Alpheus*.

After the same manner *Guadiana*, anciently known by the name *Anas*, a river between *Portugal* and that part of *Spain* called *Bætica*, falls into a subterraneous passage, and after a dark and dismal

mal journey of Thirty two Miles, breaks forth again to ſee the light of this upper World. Whence the *Spaniards* boaſt that in their Kingdom they have a Bridge upon which there ſtand ſtately Woods and fair Meadows, and on which ſome thouſands of Cattle are fatted.

But we need not ſearch into remote parts of the World, when our own Countrey furniſhes us with diverſe of theſe Examples, to ſhew us that there is no part of the Earth but what is fiſtulous and bored through with innumerable Paſſages divaricated up and down far and wide. The *Mole*, a ſmall Rivulet in *Surry*, falls into a hollow of the ground not far from *Boxhill* (ſo called from the great number of Box-Trees there growing) and riſes again at ſome conſiderable diſtance.

Now by theſe Rivers throwing themſelves into a Cave or opening of the Earth, and continuing their Courſe, ſome of them at leaſt, for many Miles, and then ſhewing themſelves again, we are ſenſibly taught that the Earth is not one ſolid and compacted Maſs; but formed into many ſubterraneous Caverns, Pipes and hollow Receſſes, ſome of vaſt dimenſions and large Capacities, which beſides the Water that may be ſuppoſed in ſome to be ſtagnant, in others gliding through them, are filled with Air and Vapours, and copious Exhalations of all ſorts of Mineral Bodies.

I ſhall now conclude this Argument with the ſtory of the *Sicilian* Diver mentioned by *Kircher*, *Lib. c.* 15. of his *Mundus ſubterraneus*; taken out of the

the Archives of *Sicily*, and tranſmitted to him by the Secretary of State.

There was in the time of *Frederick* King of *Sicily* a famous Diver, who through continual uſe had made the Waters ſo familiar to him as that they ſeemed to be his natural Element, which had ſo chang'd his Nature and Temper, that he ſeemed more like an Amphibious Creature than a Man; a Cartilagineous ſubſtance like the foot of a Gooſe growing between his Fingers: Hence they called him *Piſcecola*, or *Nicholas Fiſh*. The King being at *Meſſina*, and hearing of *Nicholas*, was deſirous to be informed of the Nature of *Charybdis*, of which he had been told ſuch wonderful things. He was at firſt unwilling to undertake ſo dangerous an enterpriſe: but the King cauſing a Golden Plate to be thrown into *Charybdis*, the better to animate *Nicholas*, promiſed him he ſhould have it, if he would venture to fetch it out. *Nicholas* for the love of the Gold quickly accepted of the condition, and throws himſelf into the devouring Gulf, where, after three quarters of an hours ſtay, he was by the violence of the Water caſt up again, with the Golden Plate in his hand. So ſoon as he had refreſhed himſelf, and recovered the Fatigue of his deſcent, he was brought into the King's preſence, who demanding of him an account of all things he had obſerved in the Deep, the Diver returns him this anſwer, That he had now executed his Majeſtie's Commands, but if he had known before hand what he ſhould have met withal, he would

would not have ventured, though the King would have given him half his Dominion. The King asked him the Reason; the Diver replyes, That there were diverſe things which rendred it extremely fearful. As *Firſt*, The vehemence and force of a River boiling out of the wide jaws of the very bottom of the Sea, which could not be reſiſted by a Man though of the greateſt ſtrength. *Secondly*, The multitude of Rocks whoſe Cavities he could ſcarce enter without a manifeſt danger of his life. *Thirdly*, The Whirlpools, and violent ſtreams of ſubterraneous Waters encountring one another from the inmoſt bowels of the Rocks, that it were enough to make a man dye with fear. *Fourthly*, The vaſt companies of *Polypi*, of which he ſaw one whoſe body was as big as a man, and his Ginns ten foot long, with which had he been encompaſſed, the rude embrace would even have ſcared him to death. Beſides the multitude of *Dog-fiſh*, equalling the bigneſs of *Dolphins*, which have their Kennels about the Rocks, and armed with three rows of Teeth, with which they divide their Prey with greater facility than any Sword could cut it. Being asked, how he could ſo ſoon find the Plate, he anſwered that he found it (according to his conjecture) in the Cavity of a Rock, but if it had ſunk directly to the bottom, it had been impoſſible ever to have deſcended in ſuch violent whirlings, and tempeſtuous regurgitations of ſubterraneous Waters.

3. There

3. There are ſubterraneous Cavities of another Nature, and more remarkable, which they call VOLCANO'S or fiery Mountains, that belch out Flames and Smoke and Aſhes, and ſometimes great Stones and broken Rocks, and lumps of Earth or ſome Metallick mixture; and throw them to an incredible diſtance by the force of the Eruption. Theſe argue great vacuities in the Bowels of the Earth, and Magazines of combuſtible matter treaſured up in them. And as the exhalations within theſe places muſt be copious, ſo they muſt lye in long Mines or Trains to do ſo great Execution, and to laſt ſo long. 'Tis ſcarce credible what is reported concerning ſome Eruptions of *Veſuvius* and *Etna*? Hiſtory tells us that ſome Eruptions of *Veſuvius* have carried Cinders and Aſhes as far as *Conſtantinople*: *Ammianus Marcellinus* ſaith, That they were ſo affrighted with them, that the Emperor left the City, and that there was a day obſerv'd yearly in memorial of it. *See Dr. Burnet's Theory of the Earth, l. 1. c. 9.*

Etna is of greater fame and fury, a Chronicle of whoſe more remarkable Eruptions we have in *Kircher* his *Mundus ſubterraneus*. The laſt which happened in the year 1669. is no whit inferiour to any foregoing, the melted matter which the Mountain poured forth extending in breadth ſix miles, and running as far as *Catania*, forcing it's paſſage even into the very Sea, and forming a convenient Port of that melted Matter. It is excellently *Mund. Subter. l. 4.*

well

well described by the Earl of *Winchelsea* in a Letter to King *Charles* the Second, afterwards Printed, who in his return from *Constantinople* touched at *Catanea*, at the time when the Mountain flamed.

There is no quarter of the World destitute of these flaming VOLCANO'S. *Asia* abounds with many of them up and down. *Africa* has no less than Eight remarkable *Volcano's*, besides innumerable Crater's and sulphureous Grotto's or Caves. In the New World or *America*, in that vast Chain of Mountains called the *Andes*, there are reported to be no less than Fifteen; some of which by the great quantities of sulphureous Matter which they contain, and terrible Eruptions, have brought unspeakable Calamities to the Kingdom of *Chile*, absorbing and swallowing up whole Cities by prodigious Divulsions of the Ground, and over-turning others by violent Concussions. In the bowels of which Mountains there are Caves or Subterraneous Receptacles of such Extent and Capacity as to equal whole Regions: in which are likewise the Cataracts of mighty Rivers, which poun their Waters with such a horrible noise, as is beyond expression. So that Nature here seems to keep house underground, and the hollows of the Mountains to be the funnels or Chimneys, by which the smoke and fuliginous matter of those everlasting Fires ascends.

And

And leſt the North ſhould be thought condemned to the intlemency of eternal Cold, Nature, or rather the Wiſe Author and diſpoſer of Nature, hath placed there likewiſe divers VOLCANO'S, as *Hecla* in *Iſlandia*, whoſe top though covered with perpetual Snow, yet the roots flame with inextinguiſhable Fire, belching forth out of its Cavities with formidable Thunders, ſuch vaſt quantities of Stones and Aſhes, as render all the circumjacent ground naked and barren.

And in *Greenland* nearer to the very Pole, there is ſaid to be a VOLCANO or flaming Mountain; at the foot of which (as is reported by *Bartholomew Zanet*, the King of *Denmark*'s chief Admiral, who by I know not what chance was caſt upon thoſe coaſts) there is a Monaſtery of Dominican Friars, and not far from it a Flaming Mountain, at whoſe foot a hot Spring breaks forth: by theſe Waters derived in pipes, not only all the Cells of the Monks are heated like ſtoves, but their fleſh and bread is baked. The Mountain belches forth a ſort of Pumice ſtone, or *Tophus*, with which the whole Monaſtery is built; for the *Tophi* being ſoaked in this Water, ſtick together as if by a kind of Bitumen. Here likewiſe are curious Gardens watered with this boiling Water, in which are all ſorts of Flowers and Fruits. And after this Water hath run through the Gardens, it falls into a Bay or haven hard by, whereby it comes to paſs that the Water there is never Fro-

zen, and for that reason frequented by innumerable Fowls and Fish, which abundantly suffice the inhabitants for Food.

The like Flammivomous Mountains are observed towards the Southern Pole.

To shew us further that the Earth is every where replenished with these deep and dark caverns and recesses: Miners and those that work under ground, meet with many more in the bowels of the Earth, that never reach to the top of it. Burrows and Chanels, and Clefts and Caverns that never had the comfort of one beam of light since the first formation of the Earth. And where we think the ground is firm and solid as upon Heaths and Downs, it often betrays its hollowness by sounding under the Horses feet, and the Chariot wheels that pass over it. We do not know when and where we stand upon good ground, if it was examined deep enough. So that it would amaze the stoutest heart, and make him ready to dye with fear, if he could see into the subterraneous world, and view the dark Recesses and Apartments of Nature under ground; and behold that even the strongest of our Pyles of building, whose foundation we think is laid firm and fast, yet is set upon an Arch or Bridge, made by the inclining and bending of the parts of the Earth upon one another, over an immense or prodigious Vault, at the bottom of which lyes an unfathomable Sea, and its upper hollows filled with stagnating Air, and with the exspirations of sulphureous and bituminous

Dr. Burnet's *Theory of the Earth*, l. 1. c. 9.

minous Matter. Upon such a dreadful Abyss it is that we walk and ride and sleep, and are sustained only by an Arched Roof not of equal thickness in all places.

SECT. III.

THIS being the present state and frame of the Earth, it follows, *First*, That no place can promise it self an immunity and freedom from Earthquakes, because there is no Countrey but what is perforated by these subterraneous Hollows and Pipes: And the more Cavernous any Region is, the more obnoxious to Earthquakes. For were the Earth one solid and entire Mass, closely compacted together, there could never have been naturally any such dreadful PHÆNOMENON as an Earthquake. For, whatever is the Cause of Earthquakes, it is evident, that it passes or glides along through the subterraneous Cavities of the Earth. And we have before shewed, That there is no vast tract of Land, or quarter of the World, but abounds with VOLCANO'S, sulphureous Craters, and ÆSTUARIES, from which by greater Cavities branched every way into smaller Pipes, the subterraneous Heat is carried through

all parts of the World. As in the ſtructure of a Humane Body, there is not the leaſt part but is furniſhed with capillary Veins, which convey the Blood to it.

Secondly, Things being made by an Infinite Wiſdom, there may be diverſe ends deſigned by that Omnipotent Architect, in ſcattering theſe VOLCANO'S up and down the Earth; among which this ſeems to be very clear and viſible, *viz.* For the Vegetation of the Earth, and the Production of all ſorts of Minerals and Foſſils, which without this ſubterraneous Fire diſperſed every where through the Veins of the Earth, could ſcarce ever have been effected; eſpecially in the colder Climates of the World, whatever may be thought to be done in the Torrid Zone by the Action of the Sun, and in thoſe places which are more immoderately ſcorched by his direct beams. And that there is ſuch a Vital Heat imparted from ſubterraneous Fire appears, in that Snow falling upon the Glebe or Turf newly turned up by the Plow, melts and diſſolves upon it, till the coldneſs of the Ambient Air cauſe the Agitation of its Parts to ceaſe. So that for any Reaſon I can ſee to the contrary, the fertility of Northern Countries owes it ſelf in a very great meaſure to the ſubterraneous Fires diſperſed through them, and ſo likewiſe thoſe of the ſame Latitude in the oppoſite Pole. And further, as none of the leaſt ends, that God may continue and keep up a lively

ſenſe

ſenſe of his Being and Providence, by letting looſe theſe raging Fires to rend and tear the Earth with vaſt Chaſms and Diviſions, by which to chaſtiſe a wicked and Atheiſtical people, and to manifeſt his Power over not only the upper but lower Regions. For ſuch is the exquiſite Art of Divine Wiſdom in the contexture of the Earth, that one and the ſame Contrivance ſhall be ſubſervient to accommodate to various Ends and Purpoſes. *Virgil* ſeems to make ſome gueſſes and imperfect Deſcription of ſome of theſe ſubterraneous Regions, when he introduces the Nymph *CYRENE* opening the Waters to make a paſſage for her Son into theſe infernal ſhades,

Duc age, duc ad nos, &c.

Come lead the Youth below, bring him to us,
The Gods are pleas'd our Manſions he ſhould ſee;
Streight ſhe commands the floods to make him way,
They open their wide boſom, and obey;
Soft is the path, and eaſie is his tread,
A watry Arch bends o'er his dewy head;
And as he goes, he wonders and looks round,
To ſee this new found Kingdom under ground.
The ſilent Lakes in hollow Caves he ſees,
And on their banks an echoing Grove of Trees;
The fall of Waters 'mongſt the Rocks below,
He hears, and ſees the Rivers how they flow;
All the great Rivers of the Earth are there,
Prepar'd as in a womb by Nature's care.

Laſtly,

Last, to his Mothers bed-chamber he's brought,
Where the high roof with Pumice stone is wrought.

And if we could open a way into the inner Region of the Earth, and could be admitted to a view or prospect of the subterraneous World, we should behold with wonder and amazement the various Apartments and concamerations of Nature; here immense Caves arched over with suspended Rocks, and filled with exhalations of all sorts of Minerals, and there the Orifices of lesser Ducts and Canals, opening themselves into the eternal Treasuries of sulphureous Smoke and Fire. Which *Seneca* long since took notice of, "The Laws of Nature (says he) under-
"ground, are less known indeed to us, but not
"less certain. Whatever you see above, believe
"the same to be beneath: For there are huge
"Dens, immense Recesses and large Spaces, and
"the Mountains standing upon an Arch of Rocks;
"here vast Gapings and broken hollows stretch-
"ing infinitely, which have often been the Graves
"to receive and bury whole Cities that have sunk
"into them.

Nat. Quæs. l. 3. c. 16.

SECT.

SECT. IV.

IT remains now that we conſider the moſt immediate material Cauſes of Earthquakes. And here I ſhall not think it worth the while, to diſcourſe of the ſeveral kinds which Metereologiſts make of Earthquakes, which the Reader may find in *Libertus Fromondus* his Meteors. Since they only differ gradually, and according to the greater or leſſer force or activity of prepared Matter, they either ſhake the Earth, or elſe break through and rend it with formidable Diviſions. I ſay therefore that Earthquakes are the effects of ſubterraneous Fires: For we muſt conceive the Earth not to be a Homogeneous, but a Heterogeneous Maſs throughout its whole ſubſtance, and here to be impregnated with a ſulphureous Matter; there with Nitrous, Aluminous, Vitriolate, or Mercurial; here to abound with a Bituminous ſubſtance, and there with Oker and Chalks; for theſe Exhalations being raiſed and excited from the inmoſt bowels of the Earth by the Action of a ſubterraneous Heat, diffuſe themſelves through the Pores and Fibres of the ground, and impregnate it with ſuch qualities as themſelves conſiſt of. The force of Cannons and ſubteraneous Mines uſed in the ſieges of Cities,

L. 4. C. 7. Art. 2.

Cities, loaden with Gunpowder, is ſtrange and wonderful, there being nothing ſo firm, ſolid, and well compacted, that will not in a moment be thrown down and broken in pieces; all which terrible Ravages and Devaſtations are the effects of a certain kind of Duſt made of Nitre, Sulphur and Coals. Now if an artificial Powder have ſuch an irreſiſtible force and violence, how much greater will the ſtrength of that combuſtible Matter be, which ariſes from Sulphur, Nitre, Sal Ammoniack, Bitumen, Gold, Copper, Iron, Arſnick, Mercury, and ſuch other Mineral and Metallick Spirits, with which the boſome of the Earth is copiouſly furniſhed and replenifhed.

When therefore the ſubterraneous Fire breaking its Priſon in the bowels of a Mountain, forces it ſelf into thoſe hollow Vaults that are filled and ſtored with all ſorts of cumbuſtible Matter, it raiſes an immenſe quantity of Exhalations, which ſuddenly taking fire, diffuſe themſelves far and wide through the Pipes and Cavities of the Earth, and according to their copiouſneſs, and the more or leſs firmneſs of the ſuperincumbent Earth, do either cauſe Tremblings and Concuſſions, or violent Eruptions, ſubverſions of Cities, wide and deep Gulfs, ſometimes ſwallowing the Ground, and leaving a Lake in its ſtead; and at other times thruſting up the Earth from beneath, and forming a new Mountain, and all thoſe other terrible effects which Hiſtory records of Earthquakes.

And

And that there are in *rerum Naturâ* ſuch mineral Subſtances, whoſe union is of ſufficient force to produce whatever we find recorded of Earthquakes appears, in that if you make a Compoſition of Gold diſſolved by *Aqua Regia*, *Sal Ammoniack*, and *Oil of Tartar* precipitate, and ſet it on fire, it will with a horrible crack ſtrike through whatever is near, and makes any reſiſtance, though it were a plate of Iron.

Hence it will not be difficult to give a Solution of thoſe ſtupendious effects of Earthquakes, as

1. What the reaſon is of thoſe Thunderings under ground, and that dull murmur which uſually precedes the Earthquake.

2. How an Earthquake may ſenſibly be felt in divers Countries ſome hundreds of Miles diſtant from one another, at one and the ſame time, or with a very ſmall difference.

3. How Cities and whole Regions may be abſorped and ſwallowed up.

4. Why there is for the moſt part an eruption of Waters where the Ground ſubſides and ſinks down.

5. How new Iſlands may be generated in the midſt of the Sea by the force of Earthquakes.

For the first of these, What the cause should be of those Bellowings, Thunderings, and hoarse Murmurs, in the bowels of a Flammivomous Mountain, which are commonly heard before its Eruption, as if Nature had commenced a War between two potent Enemies under ground. It was before observed out of *Seneca*, *Crede infra, quicquid supra vides:* Whatever you see above, believe the same to be acted beneath in the subterraneous Regions. And it is apparent, that the most fierce Aereal Meteors, such as Thunder and Lightning, and Whirl winds, have their original from Mineral Exhalations elevated from their dark beds beneath in the Earth, into the upper Regions by the action of the Sun, and the heat of the subterraneous Fire. Those dark Vaults, and immense Caverns under ground, seem the proper Kingdom wherein these Meteors discover their utmost fierceness, and rage the most horribly: Now wherever there is a concurrence of the same causes, there of necessity the same effects must be produced. And since Naturalists do generally resolve the causes of prodigious Thunders in the Air to some Effluvia, Halitus, or Exhalations out of the Earth, (which is evident in that hot Regions which abound much with sulphureous and other mineral Glebe, are most obnoxious to these formidable and destructive Phænomena,) it naturally follows, that those capacious subterraneous Dens which seem to equal whole Regions, and are close-

ly

ly confert and crouded with all ſorts of Mineral Exhalations, theſe Meteors ſhould moſt of all domineer. And from the accenſion or firing of theſe Exhalations ariſe thoſe dreadful Cracks and Thunders, which are uſually heard before the eruption of a burning Mountain.

That ingenious Philoſopher *Des Cartes* ſeems to reſolve the roaring and bellowing of Thunder to the fall of one Cloud upon another, as Snow rolling in vaſt quantities from the top of the Alps to the Valleys beneath, imitates, ſaith he, the like ſound or noiſe: But as Dr. *More* obſerves, this inſtance is not well ſuited to the preſent occaſion: "For a ſnowy Cloud is not near the conſiſtency, "ponderoſity, and firmneſs of thoſe Moles of Snow "upon the Alps, much leſs does that lower Cloud "upon which the higher is ſuppoſed to fall, equal "the ſolidity of the Earth. To ſay nothing of the "cavity and hollowneſs of theſe Valleys, which "much increaſes the ſound. Moreover, as he further notes "ſome Thunders are ſo vehemently "ſonorous and acute, that it is impoſſible but it "ſhould drive the lower Cloud along with it to "the Earth, the vehemency of the ſound clearly "arguing the forcibleneſs and ſwiftneſs of the "Motion. *Enchirid. Met. p. 1. c. 23.*

It were more conſonant therefore to Experience and Obſervation, to reſolve that hideous noiſe of Thunder into the violent diſciſſion and rending of the Air by the enkindled Particles; as we ſee a

ſmall quantity of *Aurum Fulminans* ſet on fire upon the point of a Kniſe, give ſuch a dreadful crack as is ſcarce to be endured. To this purpoſe I remember Mr. *Boil*, ſomewhere in his Hiſtory of Cold, relates a ſtory ſomething to this purpoſe; That the Miners in *Hungary* having dug to a vaſt depth in the Earth, are ſometimes ſenſible of an Exhalation, that catching fire at their Lights, ſinges their Hair and Faces; and therefore at the firſt approach of it they fall flat to the ground; but this Exhalation no ſooner comes to the mouth of the Pit, at the open Air, but it cauſes a noiſe or ſound equal to that in the diſcharge of a Cannon.

From hence it is manifeſt, That there may be more direful and terrible Thunders, according to the diverſity of Exhalations, in the ſubterraneous Vaults, than ever have been taken notice of in the Aereal Regions: And that thoſe hollow and dull murmurs at the foot of a flaming Mountain, owe their original to the vehement conflict of theſe enkindled Exhalations with the Air, and are the fore-runners of that lamentable Tragedy that uſually enſues and follows.

To the Second, How an Earthquake may ſenſibly be felt in divers Countries at ſome hundreds of Miles diſtance from one another, at one and the ſame time, or with a ſmall difference; I anſwer, That it hath been before ſhown that the Earth is perforated throughout with innumerable Bur-

Burrows and Cavities, and that there is a ſubterraneous paſſage or in-let from one to another, and that there is no Country but hath ſome of theſe Branches which communicate with greater and more capacious Caves and Dens; now whereever an Earthquake begins, there it is probable there is an infernal *Pyrophylacium*, or Treaſury of Fire, either under or near it, by which means, or by a mingling together among themſelves, the Exhalations being once ſet on fire, in a moment they diffuſe and ſpread themſelves like a train of Gunpowder, for there being fitly prepared Matter in all theſe Pipes and Cavities, which being all in an inſtant ſet on fire, it is no wonder if it be felt, though at a vaſt diſtance from the place where it firſt began, theſe Spirits being in their paſſage as quick as Lightning. And in thoſe places where the concuſſion is more violent, it is very rational to ſuppoſe ſome of theſe Cavities underneath; but where the Earth is more hard and ſolid, it may ſo happen, that by battering the Arch of ſome ſubterraneous Dens, by the extreme violence of theſe enkindled Exhalations, it may make even a whole Region ſhake and tremble, by reaſon of the continuity of its parts.

From hence a probable account may be given of the running of an Earthquake to a hundred and threeſcore, nay three hundred Leagues, as *Joſephus Acoſta* informs us. And 'tis reported that under the Reign of *Valentinian*, almoſt the

the whole World was ſhook by an Earthquake; which could not well be felt in all places at the ſame time, unleſs either the Concavity be continuous, or there be a Communication from one to another through ſmaller and narrower Pipes; for ſo one will receive the flame and force from another. Moreover the depth of the Cavern may cauſe that the ſame Ignebus Spirit at one ſtroke may force a vaſt portion of the ſuperficies of the Earth to tremble. For ſince the lines drawn from the Circumference to the Center of the Earth, are not parallel, but come nearer together, the deeper they deſcend; it is neceſſary that the portion of Earth intercepted between two lines ſhould be gradually ſtraitned like a wedge, and broadeſt at the ſuperficies of the Earth: whence a Cavern whoſe latitude does not exceed a quarter of a Mile, ſo that it be not far from the Center or loweſt Region, may ſuſtain all *Europe*. But the force and Energy of the exhalations included within ſuch a ſpace, muſt be incredible to move and ſhake ſo great a Mole of Earth. Therefore if it ſhould ſo happen that all *Europe* (for example) ſhould be ſhaken, it is eaſie to imagine that the fiery Exhalations are diſpoſed not in one but in divers Caverns, and ſhake the ſeveral parts of the Earth, not by one but many ſtrokes, the Flame paſſing through Chinks and Clefts from one ſubterraneous Burrow to another.

From

From the foregoing Principles, it will not be difficult to give a ſolution to the third propoſed Queſtion, *viz.* How Cities and whole Regions may be abſorped and ſwallowed up? We have taken notice afore, that Earthquakes are the effects of enkindled Exhalations, which conſiſt not only of ſulphureous and bituminous Spirits, but of Pit-Coals, Alom, Nitre, Antimony, Vitriol, Mercury, and the Halitus of all manner of Minerals, Foſſils and Metals, which Nature extracts and mixes in thoſe infernal Vaults by a ſubtler ſort of Chymiſtry, than Art can reach to the Imitation of. Now when a City or Region ſhall ſtand upon a Vault repleniſhed with this combuſtible matter, according to the profundity of the Cavity, and ſolidity of the incumbent Earth, theſe fiery Exhalations may not blow up all immediately into the Air, but by their ſudden Impetus or jolting, looſen or disjoyn a part or portion of ground from the reſt, which then by its own weight will ſubſide and ſink; of which Ravages and Devaſtations we have many examples. Thoſe two famous Cities of *Achaia*, *Helice* and *Buris*, are ſaid to be thus abſorped and ſwallowed up by an Earthquake; which *Ovid* takes notice of, *Met.* 15.

Si quæris Helicen & Burin Achaidas urbes,
Invenies ſub aquis & adhuc oſtendere naute
Inclinata ſolent cum mœnibus oppida merſis.

And

And if it be true that *Helice* was thirteen furlongs, and *Buris* forty, distant from the Sea (as *Fromondus* relates) there was likewise a great quantity of Land that sunk together with those Cities. And *Kircher* tells us in his Description of that dismal Earthquake, which beginning at *Strombalo* in the year 1638. made such a miserable havock in *Calabria*, that when he and his Companions were risen from the ground upon which they were not able to stand for the violent concussion and subsultation of the Earth, and casting their eyes upon the circumjacent places, they saw the Town of *Euphemia* covered with a mighty Mist; which being dissipated, instead of the Town they found a stinking Lake in its place. And after the same manner that famous Land of *Plato*'s called *Atlantis*, which the *Egyptian* Priests told *Solon* the *Athenian*, was bigger than *Asia* and *Africa*, by an Earthquake of a nights continuance sunk into the Abyss, the *Atlantick Ocean* coming in its place, and nothing remaining of that terrible shipwreck, but the *Azores*, and some few Islands scattered up and down in that Ocean: as *Fromondus* speaks; By which it seems there was some Tradition among the *Ægyptians* of the separation of *America* from our World. *Varenius* in his Geography thinks it at least probable that the Northern part of *America*, i. e. *New France*, *New England*, *Canada*, &c. were once joyned to *Ireland*, and that this separation might be caused by

Meteo l. 4. c. 9. Art. 7.

L. 1. c. 18. propos. 17.

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an Earthquake. Thus *England* might be torn from *France*, *Spain* from *Africa*, and *Sicily* from *Italy*, the intermediate Earth ſinking, and the Sea coming in its ſtead.

We come now to the Reſolution of the Fourth Queſtion, Why there is for the moſt part an eruption of Waters where the ground ſubſides and ſinks down? To this end we may conſider that there are *Hydrophylacia*, *i. e.* Repoſitories or Treaſuries of ſubterraneous Waters, as well as ſubterraneous Fires, of different magnitudes and capacities, which have likewiſe their leſſer Pipes and hollow Branches, through which the Waters are diſtributed and diſperſed up and down; and ſome of theſe Caves may be of that depth as to reach to the vaſt watry Abyſs beneath. Now when by the force of thoſe furiouſly agitated Exhalations a portion of Earth ſhall be looſened from its continuity with the reſt, and ſink and fall down into one of theſe Repoſitories, the ſuddenneſs of the deſcent of ſuch a mighty *Moles* or quantity of Earth, muſt forcibly drive up the Waters like a Flood or Torrent to the ſurface of the ground, through that wide Gulf left by the deſcending Earth: As was experienced in that terrible Earthquake in *Jamaica*, when a part of the Town of *Port-Royal* ſinking, a Flood of Water immediately guſhed out. It were endleſs to bring the ſeveral inſtances of this Nature, and therefore I ſhall paſs to the laſt Queſtion,

How new Islands may be generated in the midst of the Sea by the force of Earthquakes? Of this nature many examples are related in History; *Pliny* in his Natural History making mention of *Delos* and *Rhodes*, *Anephe*, *Nea*, *Ajone*, and among the *Cyclades*, *Thera*, and *Therasia*, and *Thia*, which he says first saw the light of this upper World in his time, *Junius Syllanus*, and *L. Balbus* being Consuls, hath these words; *Nascuntur & alio modo Terræ, ac repente in aliquo Mari emergunt, veluti paria secum faciente Naturâ, quæque hauserit hiatus, alio loco reddente, i.e.* Some Lands are otherwise generated, and of a sudden arise out of the Sea, as if Nature intended to keep an equality with it self, and return as much a new in one place, as was swallowed up and absorped by a gaping Gulf in another. Of *Therasia*, *Seneca* witnesses, That it was thrust from the bottom of the Sea, in his time, by the force of subterraneous Fires, *Therasiam nostræ ætatis Insulam, spectantibus Nautis, in Ægeo Mari enatam, quis dubitat, quin in lucem spiritus vexerit?*

L. 2. C. 87. 88.

Now in the formation of a New Island, these Exhalations move much after the manner of a Mole heaving and casting up the ground; thus in one nights space a New Mountain thrust up its head a Mile high, out of the Sea near *Puteoli*, by the force of these Spirits, which were enkindled in a subterraneous Vault; which therefore was called by the name of the New Mountain.

I have diſpatch'd now what I thought the moſt conſiderable upon this Subject, there being ſcarce any Problem can be ſtarted concerning Earthquakes, but what by an attentive conſideration of the foregoing Diſcourſe, may receive an eaſie ſolution. And if any one ſhall think that theſe Phænomena being terrible and rare, that therefore they muſt needs ſignifie and prognoſticate ſtrange things; I muſt tell him, That as I am not at all inclinable to Aſtrological Vanities: ſo I think that an Earthquake may happen as well as many a blazing Star, without any ominous or direful Preſages. But if any thing can be collected from the late Earthquake with us, it is this, That as we had a long calm and ſerenity of Weather after it; ſo a laſting Peace and Tranquillity will be ſetled in the World, by the Conduct and Victorious Arms of KING *WILLIAM*, Whom God long preſerve.

FINIS.

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